Syllabus for MATH 102 SINGLE VARIABLE CALCULUS II

Spring 2021 (Last updated: Mar. 10th, 2021.)

Instructor:	Dr. Hongdi Huang	**Time:**	MWF 9:45– 10:40 AM; 1:30–2:25 PM
Email:	h237huan@rice.edu	**Place:**	Zoom

Format: Due to the pandemic we will conduct this course fully online. You can find the Zoom link from the Canvas.

Office Hours: Mon. 5:10– 6:10 PM and **Wed. 10:50–11:50 PM** starting from Feb. 1st and Jan. 27th. Extra office hours request are accepted by email appointments.

Piazza: I also encourage you to post your questions on Piazza since the system is highly catered to getting you help fast and efficiently from classmates, the TA, and myself. Signup the Piazza here.

Course website/link: Lecture videos, Note and Homeworks will be uploaded in Canvas.

Online platforms: This course will combine **five** online platforms:

Canvas, Zoom, Piazza, webWork, and GradeScope.

You should spend time acquainting yourself with each of them. I explain below how we will use each platform in this course.

Course description: A second course in one-variable Calculus.

1. We begin with **techniques of integration** (u-substitution, integration by parts, trigonometric substitutions, partial fractions), and we move on to "improper" integrals, and try to make sense of finite areas under a curve that extends infinitely in some direction.

3. The second part of the course is devoted to the concept of **Taylor polynomials** (which are incredibly useful because they can approximate nice functions, while being easy to integrate), and their infinite counterparts: **Maclaurin and Taylor series**.

2. Before we can embark on a study of Taylor series, we need to make sense of what on earth it means to add up infinitely many numbers together. For this, we will need a good foundation on **sequences and series**.

4. Calculus using different kinds of coordinates. It is much easier to slice a round pie into radial wedges than into small rectangles. Choosing a good system of coordinates for a problem can make your life *easier*. Thus, **Parametric equations and Calculus**.

6. **Complex Numbers**: This is a short unit, which you will *self-study* during the last study week.

Pre-requisites: A working knowledge of differentiation and basics of integration, including the Fundamental Theorem of Calculus. Math 101 or Math 105 are sufficient preparation. You cannot register for Math 102 if you have credit for Math 106.

You can sign up for this class even if you don't have official credit for Math 101 or 105. However, Math 101 or 105 might be required by you major; if this is the case, please consult a major advisor before taking Math 102.

Learning Outcomes: At the end of this course you should:

1. Be able to use techniques like u-substitution, integration by parts, trigonometric substitution, and partial fractions to evaluate a plethora of integrals whose integrands have accessible anti-derivatives.
2. Understand the concept of convergence, and what it means to add up infinitely many real numbers (a series is a sequence of partial sums!).
3. Understand how to write a Taylor expansion for a sufficiently nice one-variable function. Understand how to use a Taylor polynomial to approximate a function around a point, and be able to estimate how good the approximation is.
4. Be able to give Fourier expansions of certain smooth functions, and be able to compare Fourier expansions with Taylor expansions.
5. Understand how to do Calculus of one variable using polar coordinates, as well as parametric equations.

Drop-back policy: The Math department has a special dispensation from the Registrar's Office, because we want you to try to take the most advanced Math class that you are prepared for. If you find yourself feeling like you are not prepared to take Math 102 because your background in Calculus is not strong enough, then you can "drop-down" to Math 101 all the way until the Friday of the 7th week of class.

Text: *Calculus Volume 2*, by open**stax**™. This book can be *freely and legally* downloaded at openstax.org. You can also purchase a hardcopy from the same site; the book is sold at cost. Roughly speaking, we will cover Chapters 1, 3, 5, and 7, as well as some supplementary material on Fourier Series and Complex Numbers.

Midterm and Final Exams: There will be two Midterms and a Final exam.The first midterms will be on Thursday, Mar. 4th and the second one will be on Tuesday, Apr. 13th. They will be 7pm-9pm, with an alternate time slot for students with an inconvenient time zone. The time and day for the Final Exam will be determined by the Registrar's office and is not currently available. It is the policy of the Mathematics Department that no final may be given early to accommodate student travel plans. If you make travel plans that later turn out to conflict with the scheduled exam, then it is your responsibility to either reschedule your travel plans or take a zero on the final.

Homework: There are **two** components to the homework: webWork and written assignments.

1. **webWork:** webWork is an online homework system. Homework will be due **every class day at 11:59PM CDT**, starting on **Friday, Jan. 29th**. It will be assigned through the webWork website. You will receive an email enrolling you on webWork by **Jan. 28th**. All homework problems on webWork are to be completed online, and are quite similar to textbook exercises.

   It is **strongly recommended** that you keep a notebook where you write down complete solutions to the assigned exercises; you can use this notebook to study for exams. Imagine that a fellow student will be reading your homework notebook to study for an exam. If your work is not detailed enough to be useful, it is unlikely to earn much credit if it were being graded. Another student reading your solutions should be able to guess at the question your are trying to answer without referring to the textbook.

2. **Written Assignments:** Every week I will assign 4–6 problems whose solutions you can either type up using LaTeXor write up by hand, and then scan and upload to **GradeScope**. Written assignments will be due by **5pm CDT on Fridays**. This will give us time to get the system well set-up; I will enroll you directly on GradeScope through Canvas. To scan your solutions to problems, I recommend the App **Genius Scan**, though you are welcome to use whatever works for you!

The problems in the written assignments will be of a nature that cannot be covered by online systems. They will be graded and returned to you a week after you hand them in.

Late homework assignments will not be accepted for ANY reason – instead, your three lowest webWork scores and your lowest written-assignment will be dropped.

Handwritten and Latex-ed solution sets are both acceptable. But handwritten must be legible for HW grader. Solutions should be submitted online and placed in the order of questions.

Participation: Engagement is crucial in an on-line course. We need to create a community to help sustain each other through the semester. In order to help us get started, 2% of your grade will be devoted to participation. Earning this portion of your grade is very simple: attend to the online courses and ask questions frequently.

Assessment, % of Course Grade: When computing final course grades, a student's exam scores are normalized against scores of all students in Math 102 this semester, not just those in this section: all Math 102 sections take the same exams, so this practice is simply common sense.

Homework will count as 21% of your final grade (3% webWork, 18% paper assignments). Your final grade will be computed as

$$21\%\text{ Homework} + 2\%\text{ Participation} + \text{Max. of } \begin{cases} 24\%\text{Midterm I} + 23\%\text{ Midterm II} + 30\%\text{ Final} \\ 18\%\text{ Midterm I} + 23\%\text{ Midterm II} + 36\%\text{ Final.} \\ 23\%\text{ Midterm I} + 18\%\text{ Midterm II} + 36\%\text{ Final} \end{cases}$$

Collaboration Policies: For each homework, you should work individually on the problems at first. Collaboration and discussion with others are encouraged, but only after you have given the problems a good amount of independent trying. You are also welcome to talk with me about the homework at office hour (by appointment), but again only after that you've worked on it. You should do the final write-up alone without looking back any writing or notes produced during your collaboration. Please note the names of your collaborators on your problem sets.

Title IX Statement: Rice University cares about your wellbeing and safety. Rice encourages any student who has experienced an incident of harassment, pregnancy discrimination or gender discrimination or relationship, sexual, or other forms interpersonal violence to seek support through The SAFE Office. Students should be aware when seeking support on campus that most employees, including myself, as the instructor, are required by Title IX to disclose all incidents of non-consensual interpersonal behaviors to Title IX professionals on campus who can act to support that student and meet their needs. For more information, please visit `safe.rice.edu` or email `titleixsupport@rice.edu`.

Disability Accommodation: Any student who has a need for accommodation based on the impact of a disability should contact me privately to discuss the specific situation as soon as possible. Students should also contact Disability Resource Center (DRC) at adarice@rice.edu or 713-348-5841 to obtain a Letter of Accommodation to present to me and to learn about further resources: `https://drc.rice.edu/`.

Statement on Collegiality, Respect, and Sensitivity: The Department of Mathematics supports an inclusive learning environment where diversity and individual differences are understood, respected, and recognized as a source of strength. Racism, discrimination, harassment, and bullying will not be tolerated. We expect all participants in mathematics courses (students and faculty alike) to treat each other with

courtesy and respect, and to adhere to the mathematics department standards of collegiality, respect, and sensitivity (link to department statement on collegiality, respect, and sensitivity goes here) as well as the Rice Student Code of Conduct. If you think you have experienced or witnessed unprofessional or antagonistic behavior, then the matter should be brought to the attention of the instructor and/or department chair. The Ombudsperson is also available as an intermediate, informal option, and contacting them will not necessarily trigger a formal inquiry.

Tentative Schedule:

Techniques of Integration

Week 1:
01/25 Section 1.5: u-substitution
01/27 Section 1.6: Integrals Involving Exponential and Logarithmic functions
01/29 Section 1.7: Integrals Resulting in Inverse Trigonometric functions

Week 2:
02/01 Section 3.1: Integration by Parts
02/03 Section 3.2: Trigonometric Integrals
02/05 Section 3.3: Trigonometric Substitution
Written Assignment #1 due.

Week 3:
02/08 Section 3.4: Partial Fractions
02/10 Section 3.7: Improper Integrals I
02/12 Section 3.7: Improper Integrals II
Written Assignment #2 due.

Week 4:
No class due to power outage

Week 5:
02/22 Asymptotic and little o notations
02/24 Section 3.7 Improper Integral and the Revised comparison
02/26 Examples of Improper Integrals
Written Assignment #3 due.

Week 6:
03/01 **No class**
02/03 Catch-up or review lecture
03/04, 7-9PM Midterm I
03/06 Section 5.1 Sequence
Written Assignment #4 due.

Week 7:
03/08, Section 5.1 Sequence
03/10, Section 5.2: Infinite Series (Geometric series and Telescope series)
03/12, Section 5.3: The Divergence and Integral Tests

Written Assignment #5 due.

Week 8:
03/15 Remainder estimate.
03/17 Section 5.4: Comparison Test
03/19 Section 5.5: Alternating Series

Written Assignment #6 due.

Week 9:
03/22 Section 5.6: Ratio and Root Tests and a mini-review of series convergence/divergence tests here.
03/24 Section 6.1: Power Series and Functions I
03/26 **No class**
Written Assignment #7 due.

Week 10:
03/29 Section 6.1: Power Series and Functions II
03/31 Section 6.2 Power Series and Properties of Power Series
04/02 Section 6.2: Properties of Power Series II

Written Assignment #8 due.

Week 11:
04/05 Section 6.3: Taylor and Maclaurin Series I
04/07 Section 6.3: Taylor and Maclaurin Series II
04/09 Section 6.4: Some applications of Taylor Series
Written Assignment #9 due.

Fourier Series

Week 12:
04/12 Catch-up or review lecture
04/13 7-9PM Midterm II
04/14 Section 7.1: Parametric Equations I
04/16 Section 7.1: Parametric Equations II
Written Assignment #10 due.

Week 13:
Parametric equations and Calculus
04/19 Section 7.2: Calculus of Parametric Curves
04/21 Section 7.3 Polar Coordinates
04/23 Section 7.4: Area and Arc Length in Polar Coordinates

Written Assignment #11 due.

Week 14:
04/26 Complex Numbers I
04/28 Complex Numbers II
04/30 Catch-up or review lecture

Written Assignment #12 due.

Week 15 (05/01–05/04) Self-study